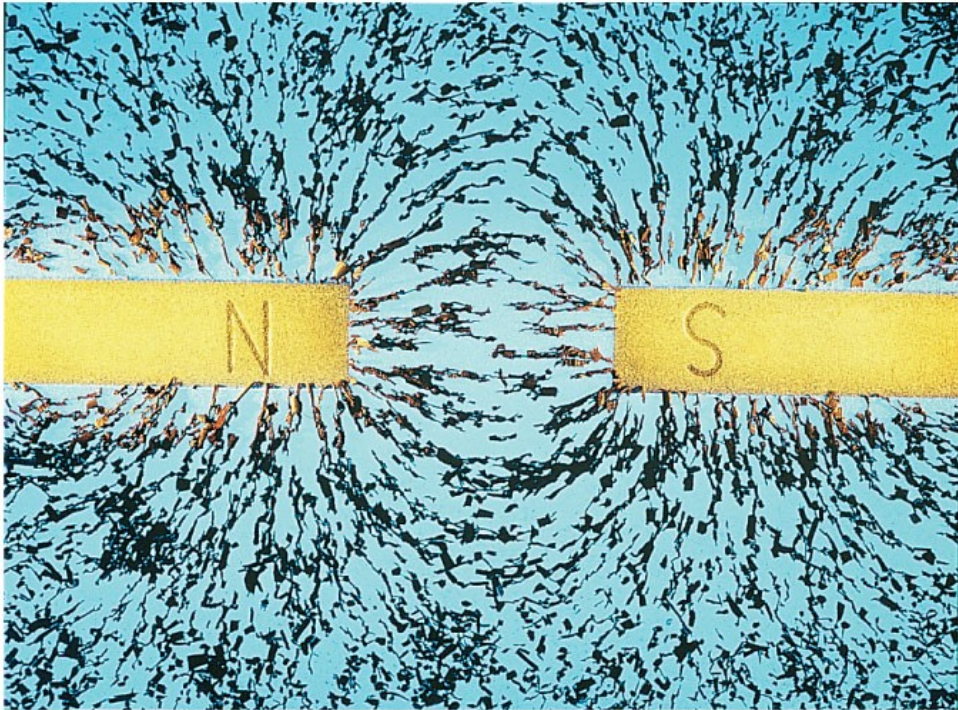


Magnetic Field Lines of a Permanent Magnet

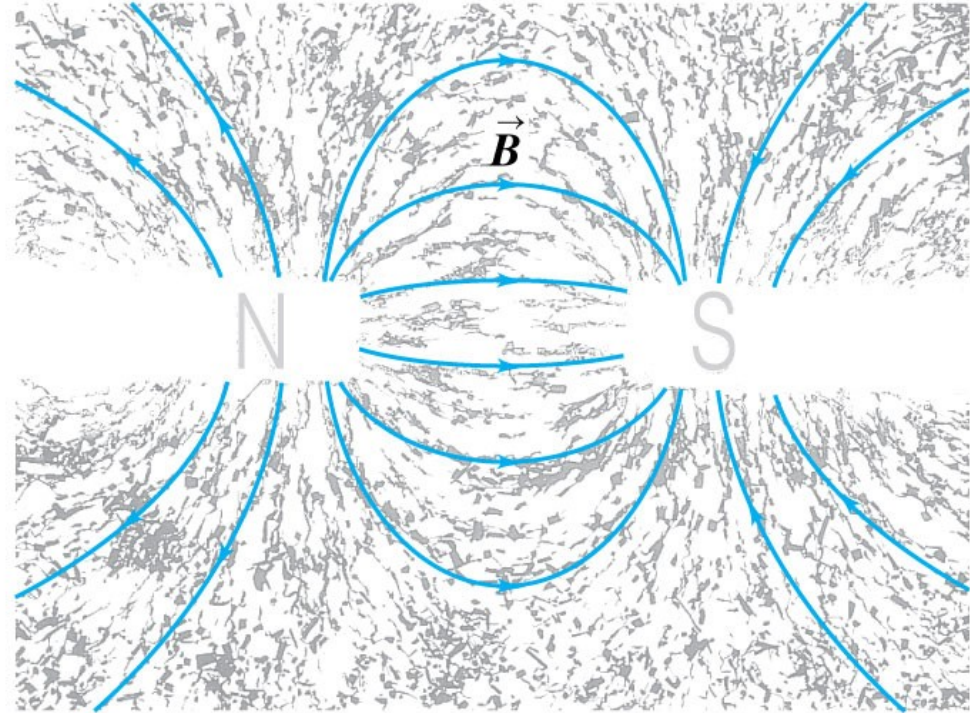
FIG. 1

(a)



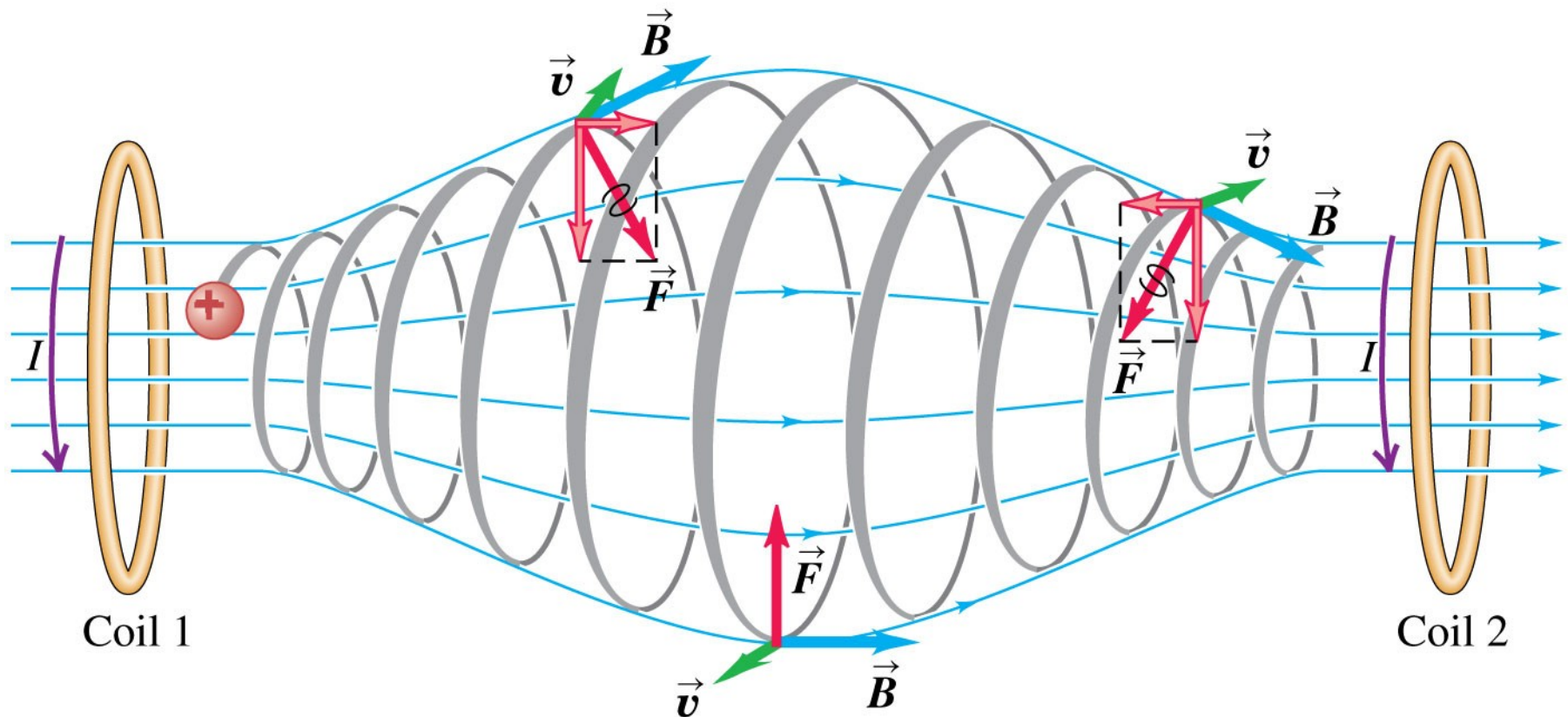
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(b)



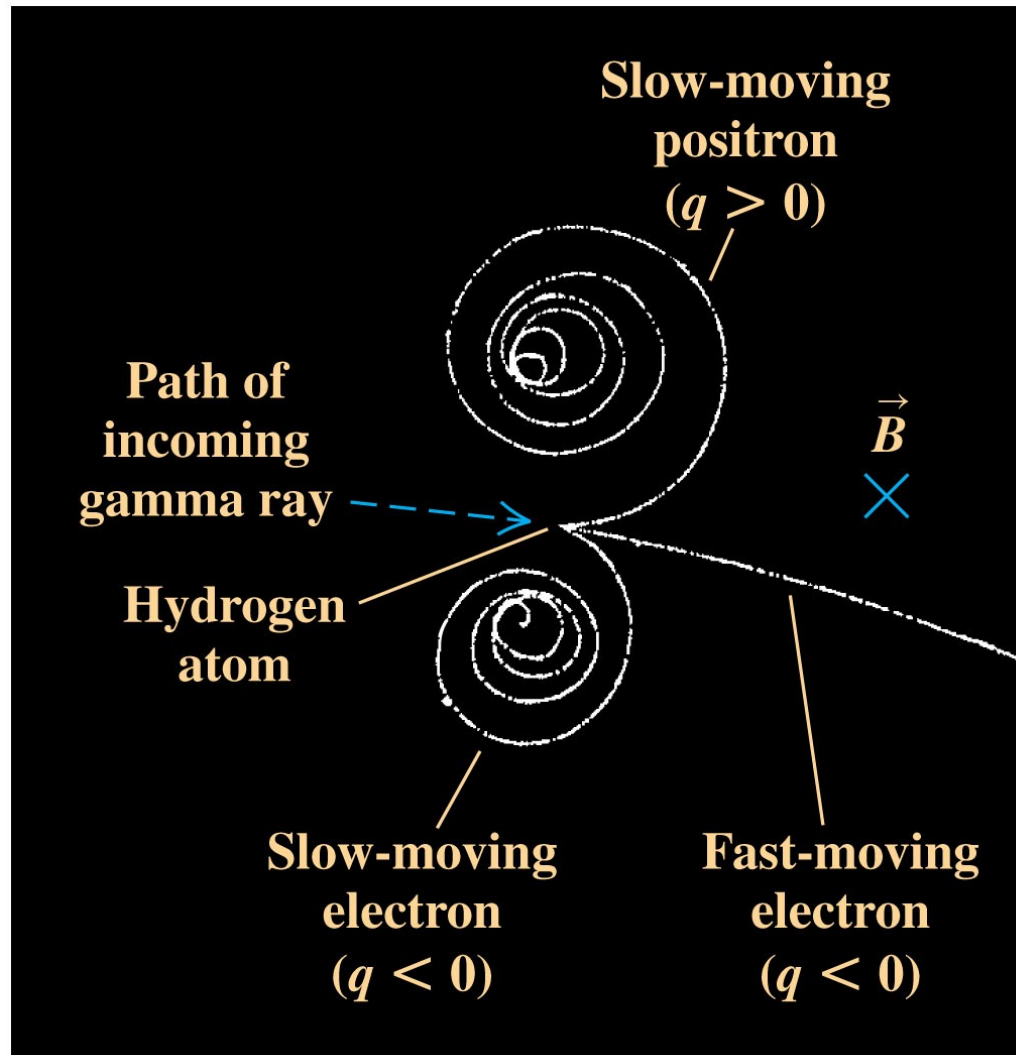
Application: Magnetic Trap

FIG. 2



Application: Bubble Chamber

FIG. 3

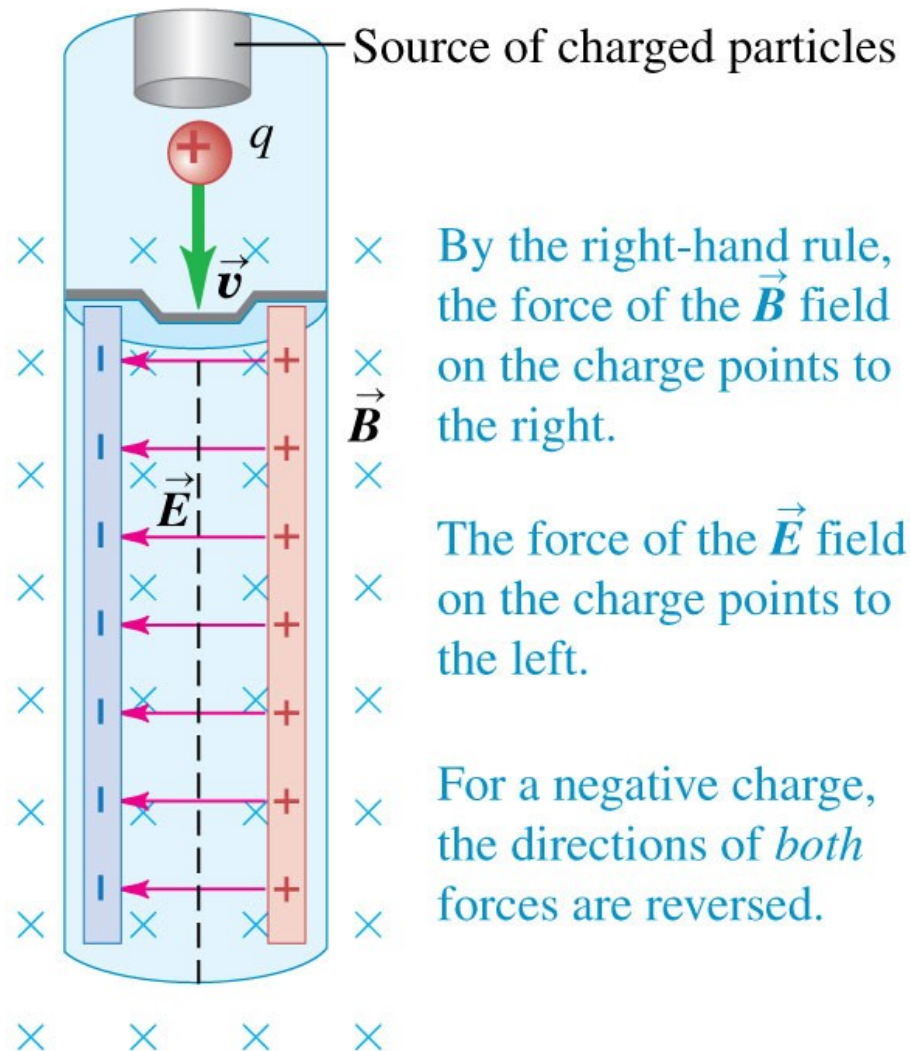


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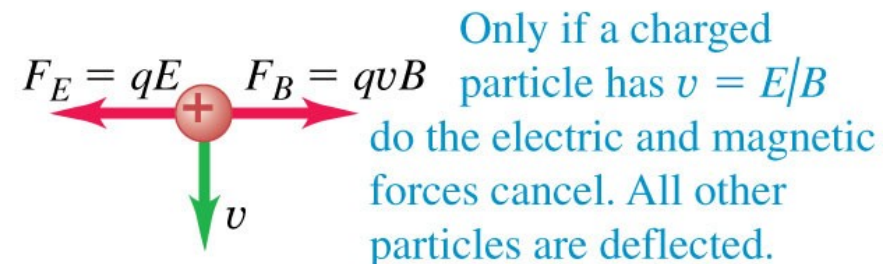
Application: Velocity Selector

FIG. 4

(a) Schematic diagram of velocity selector

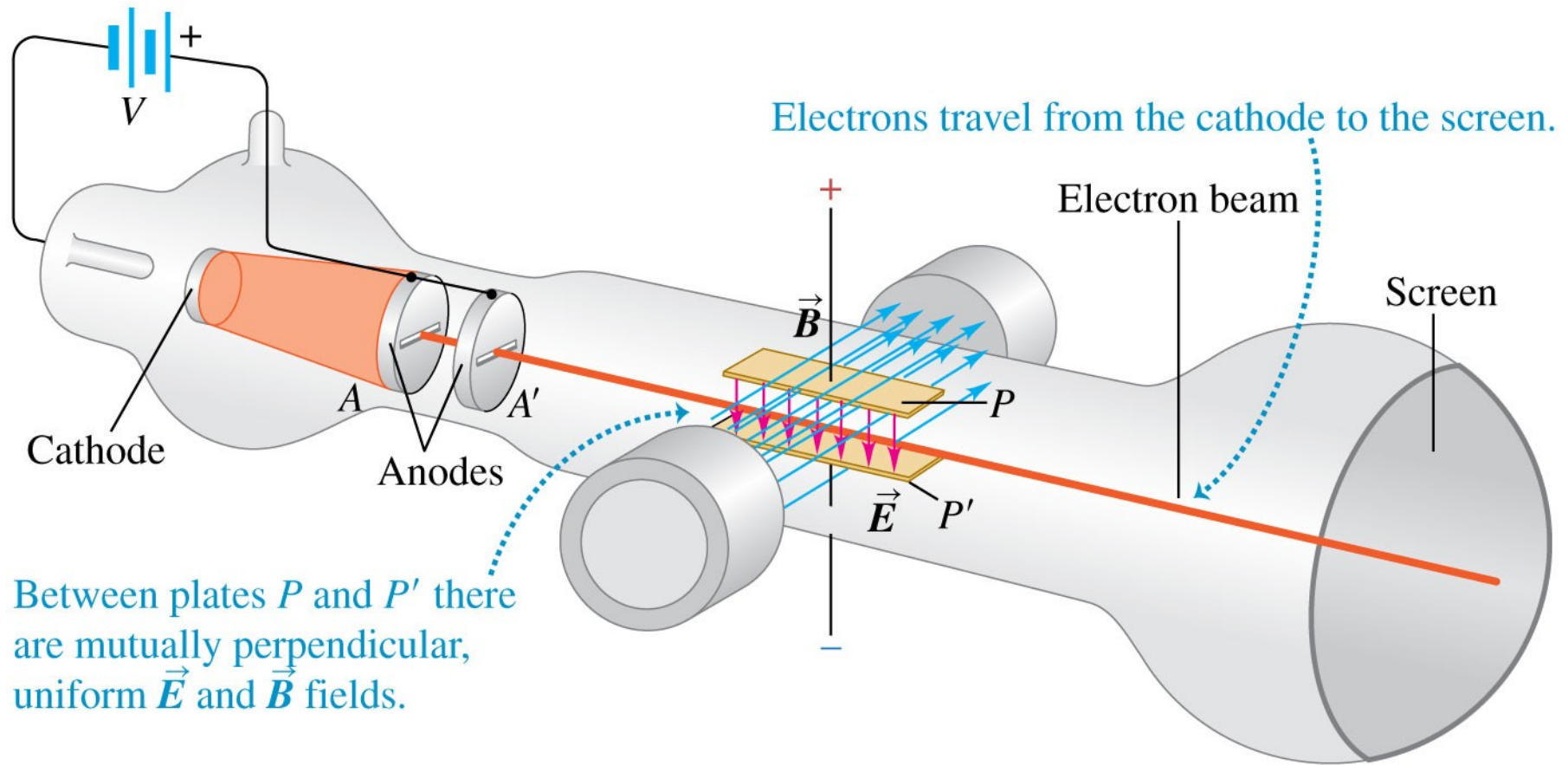


(b) Free-body diagram for a positive particle



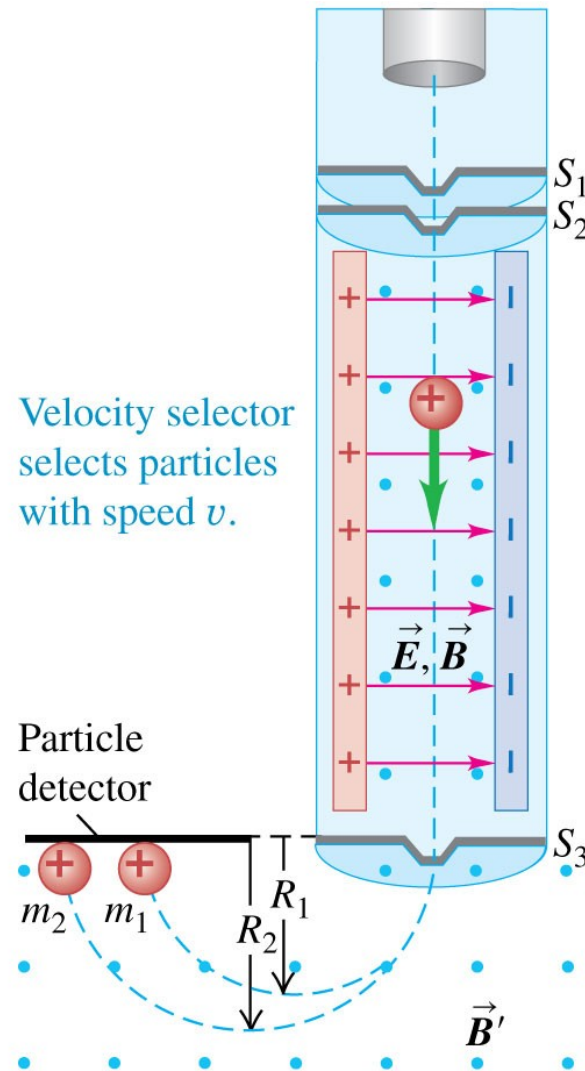
Thomson's Experiment (e/m ratio)

FIG. 5



Application: Mass Spectrometer

FIG. 6



Velocity selector
selects particles
with speed v .

Particle
detector

Magnetic field separates particles by mass;
the greater a particle's mass, the larger is
the radius of its path.

Current Loop in a Uniform Magnetic Field

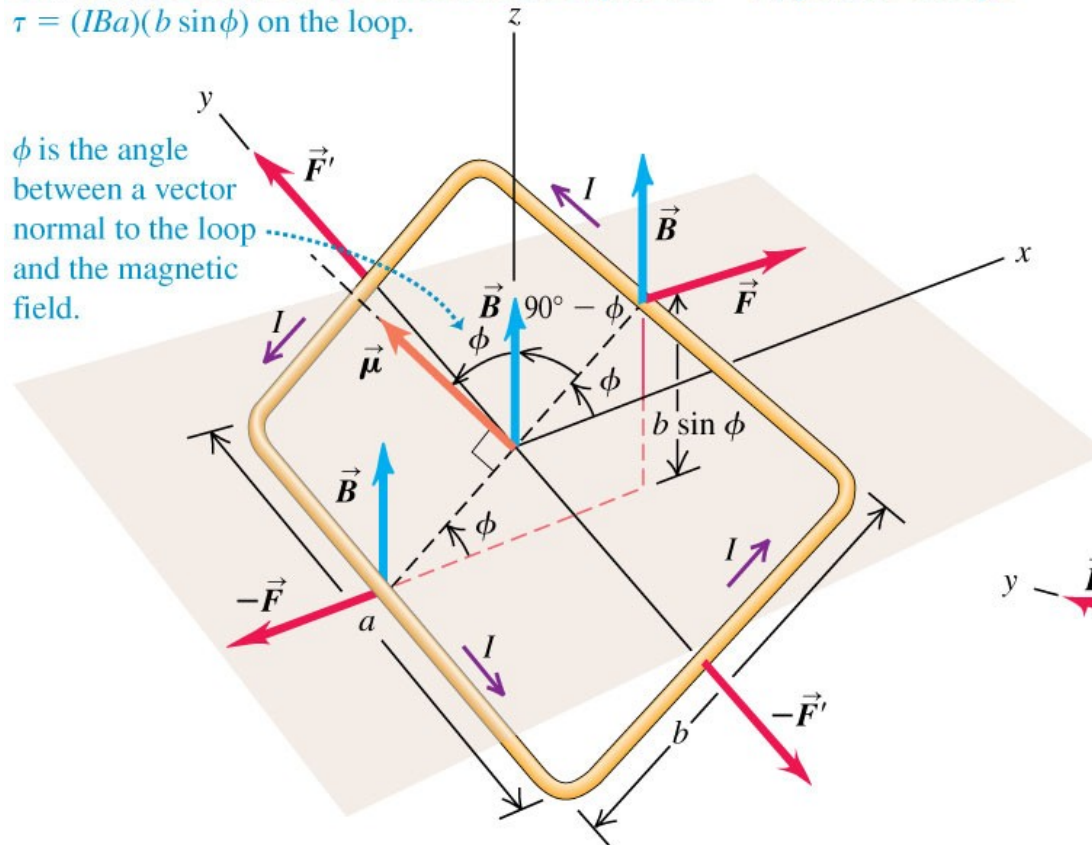
FIG. 7

(a)

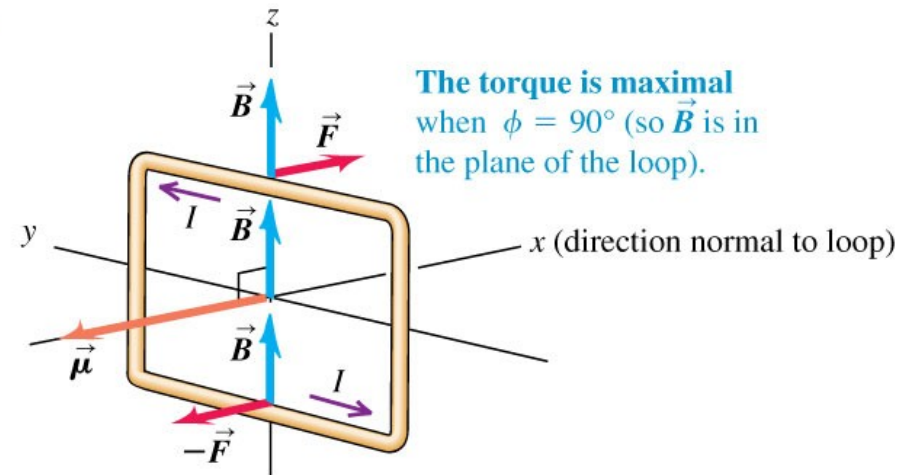
The two pairs of forces acting on the loop cancel, so no net force acts on the loop.

However, the forces on the a sides of the loop (\vec{F} and $-\vec{F}$) produce a torque $\tau = (IBa)(b \sin \phi)$ on the loop.

ϕ is the angle between a vector normal to the loop and the magnetic field.

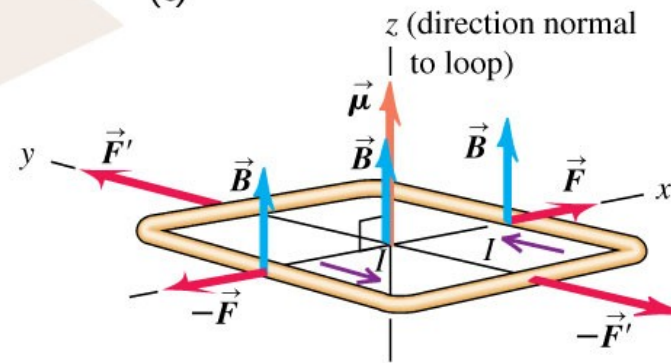


(b)



The torque is maximal when $\phi = 90^\circ$ (so \vec{B} is in the plane of the loop).

(c)



The torque is zero when $\phi = 0^\circ$ (as shown here) or $\phi = 180^\circ$. In both cases, \vec{B} is perpendicular to the plane of the loop.

The loop is in stable equilibrium when $\phi = 0$; it is in unstable equilibrium when $\phi = 180^\circ$.